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ABSTRACT

There is a myth in the African American community that only a few students are bright enough to effectively learn quantitative skills, and many African American students attend college with the assumption that they are not good at mathematics and as a result cannot choose majors that require the mastery of quantitative skills. African American students are said to learn better via visually-aided instruction, to prefer to have instruction demonstrated in a variety of ways, and to prefer participatory learning. At an undergraduate institution where some students have limited preparation in quantitative skills, a strong remedial program is often in place, and deficiencies are eliminated during the freshman year. Statistics indicate that in junior level quantitative courses, many of the students are still ill-prepared. In an alternative instructional strategy called "in-class assignment," two instructional strategies are used: (1) in-class individual and group problem-solving sessions between lectures, and (2) the use of examples that reflect the socioeconomic backgrounds of the students. This approach has resulted in a decline in the rate of absenteeism, an increase in the desire to learn quantitative skills, and an increase in the number of students who perform at a level higher than their standardized test scores suggest. (Author/JLS)

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"THE CHALLENGE OF TEACHING QUANTITATIVE SKILLS TO STUDENTS WITH LIMITED MATHEMATICAL BACKGROUND"

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ABSTRACT

At an undergraduate institution where some students have limited preparation in quantitative skills, a strong remedial program is often in place, and deficiencies are eliminated during the freshman year. Statistics indicate that in junior level quantitative courses, many of the students are still ill-prepared. In an alternative instructional strategy called "in-class assignment," (1) in-class individual and group problem-solving sessions between lectures, and (2) the use of examples that reflect the socio-economic backgrounds of the students, have led to a decline in the rate of absenteeism, an increase in the desire to learn quantitative skills, and an increase in the number of students who perform at a level higher than what their standardized test scores would indicate.

Paper presented at the 3rd annual HBCU Faculty Development Symposium held at Memphis, TN October 10-13, 1996, and now submitted to the ERIC Clearing House for Review.

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"THE CHALLENGE OF TEACHING QUANTITATIVE SKILLS TO STUDENTS WITH LIMITED MATHEMATICAL BACKGROUND"

INTRODUCTION

Teaching students with limited preparation for college-level material presents several challenges to instructors. Teaching is a private enterprise in which only the instructor determines what and how students are taught. Moreover, how a student learns depends on the student. Unlike primary schools where uniform curricula may be required for each grade level, each instructor in a college or university in many respects, independently selects what subject matter to be taught, how the materials are presented and how students are evaluated. Because of the varied levels of preparation among the students, an instructor must seek new approaches in order to address, in most instances the special needs of each category of students. Class room strategies which are accommodating to the special needs of students, have the potential of achieving considerable success in reducing the doubts in their minds of their abilities and capabilities to learn quantitative skills. One such strategy, hereafter, referred to as "in-class assignment" has great potential of accommodating the special needs of most students enrolled in undergraduate programs.

Although the quality of instruction is critical in determining the outcome of education, students' natural abilities and motivational levels are equally important. Students who are highly motivated and who frequently ask questions in class also show more interest in the subject matter, and are more likely to do better in class. In addition, instructors who encourage

active student participation in their classes are rewarded by the important contributions of the students in the learning process. Meyers and Jones (1993) note that participation, which provides students with opportunities to apply materials learned, helps to increase the likelihood that their various learning styles will be accommodated. Also, Lovell-Troy (1989) point out that teaching techniques that encourage active learning in the class rooms challenge instructors to meet the higher level instructional objectives of taxonomy, comprehension, application, analysis, synthesis and evaluation. The in-class assignment strategy provides an excellent opportunity for students to actively participate in class.

In this paper, I will discuss certain challenges faced by instructors who teach quantitative courses to students with limited mathematical background, and the strategies that can be used to overcome them.

BACKGROUND

There is a myth in the African American community that only a few students are bright enough to effectively learn quantitative skills, and/or major in mathematics, statistics and/or economics. This misconception arises from received theories which claim that African Americans are incapable of achieving similar levels of competencies in these fields as their White and Asian counterparts. Many African American students therefore attend college with the assumption that they are not good at mathematics and as a result cannot choose majors that require the mastery of quantitative skills.

Recent data show that very few African American students major in Physics, Engineering, Chemistry, Mathematics, Computer Science, Statistics, and/or Economics (Taylor, 1996a). On the other hand, enrollment in the social science disciplines is disproportionately large as students avoid courses that they suppose would require mathematical skills. Students are therefore surprised when a mathematics or statistics class is a requirement for other advanced level courses in their disciplines. When asked why they do not generally major in these areas, a usual response is that they are not good at mathematics, or that they are not quite sure of what to do after graduating.

The myth and its effects are now receiving wider attention among critics of higher education, as enrollment of African Americans in the above mentioned disciplines continue to lag behind those of other groups in the nation (Taylor 1996b, Stein 1996, and Shabazz, 1995).

Many African American students graduate with limited proficiency in information processing, data management and analytical techniques; skills necessary to succeed in today's work place. Some critics point to differences in genetic traits among the races, as the reason for the poor performances of African American students in quantitative courses. Because research in this area is very preliminary, ethnic and racial differences cannot fully be held accountable for explaining the inadequate training in quantitative skills received by many minority students prior to college (Heiss 1996). Rather than blame student background and profile, other critics question the effectiveness of schools, especially poor schools in preparing

high school graduates for the labor market of the future.

A panacea to inadequate preparation for college is the remedial courses in community colleges, four year colleges and now at Universities across the country. For Historically Black College and Universities, it was natural to have in place a program that addressed the academic needs of these students from "at risk" schools. Remedial courses are usually courses in English and Mathematics skills that students ought to have acquired at High Schools. Remedial courses are frequently recommended to assist minority students admitted in predominantly white institutions as well. In 1995, for example, 37% of the freshmen class at the University of Memphis enrolled in at least one remedial or developmental course. However, of the 1,783 students in remedial and developmental courses, 58 percent were white and 37 percent were Black. Evidently, enrollment in remedial courses now cuts across racial and ethnic classifications. Thus leading one to conclude that contemporary remediation points to failures of schools, in general.

CHALLENGES TO EFFECTIVE INSTRUCTION

The following challenges are faced by instructors wanting to promote and provide effective learning in undergraduate quantitative courses: institutional structure, students attitude toward learning, learning styles, the financial resources and obligation of students and other factors such as teacher expectations, peer pressure, poor self-esteem.

Institutional Structure

The structure of the instructional delivery system is central to how instruction is given and the extent to which students are learning. By structure is meant the scheduling of courses vis a vis extracurricular activities, class sizes and student/teacher ratios. The two major systems of instructional delivery in higher education are the semester and the quarter systems. Another system of less popularity is the modular system. The modular system covers a period of eight weeks in which classes are scheduled to meet for one and a half hours a day, five days a week. There is a one hour break in the morning followed by the lunch hour. Day classes end by 3:00 p.m., unless a course includes a laboratory component, in which case, it is scheduled anywhere between 3:00 and 6:00 p.m.

The eigth-week modular or "semester" system of instruction is structurally challenging to both the students and instructors. For example, meeting classes daily exacerbates the usual classroom management problems. Attention decline in class, coupled with high levels of unpreparedness among the students add to teacher challenges. Because students come to class with incomplete assignments and/or are late in completing the assignments, instructors experience stress overload.

Regardless of the system of instruction, frequent absences by some students force an instructor to repeat materials already presented in previous classes. Among students who skip classes, those with notable deficiencies have problems recovering, and easily fall further behind. Since lessons are planned and given in sequence, missing key lessons creates an obvious gap in the

student's ability to grasp the key concepts. To raise the attendance level, an instructor must place sanctions on students who miss a considerable number of classes in a given semester.

Attitude Toward Learning

One can argue that a difference exists in the attitude of many African American students toward learning. College students in general, show considerable "math anxiety", but when students already weak in high school mathematics, are required to take quantitative courses in college, the level of anxiety is heightened even more. These students come to class with a low expectation of themselves, and thus are best candidates for in-class group assignments. Taylor (1996a), notes that enrollment of young African Americans in engineering programs and other quantitative courses continues to be low, because of a decline in motivation among African American High school students. He concluded that "they do not want to be in an eat-sleep-study mode for a minimum of five years, required for completing an engineering degree." Also, peer pressures to fit in result in some of these students not applying themselves adequately enough. Heiss (1996) adds that African American family structure has effects on high school students' educational aspirations and expectations, their preparedness for school, their grades and dropout rates . Students from single parent (mother only) families were more likely to show lack of preparedness for learning and motivation to succeed in school. Most students who often skip classes and thereby miss important lessons, are also less likely to ask neither the instructor nor their fellow

students about lessons missed. Many others do not take advantage of instructor's office hours nor visit the student tutors to clarify concepts not clearly understood in class.

The ACT scores of many students who attend typical HBCU's are usually lower than those who attend other universities. As a result students in traditional colleges are more highly motivated and come prepared to achieve at higher levels in a very competitive academic environment. While the departure in attitude from the norm may be blamed on the more stringent admission requirements for highly motivated students in universities, in other cases most minority students are influenced by their peers. There are cases where students are reluctant to demonstrate their true abilities because they are afraid of the reaction of their mates, who prefer not to.

Learning Styles

There is a consensus among advocates of curriculum and instructional reform in higher education that all students can learn regardless of previous backgrounds prior to entering college. Despite individual limitations and habits acquired in "at risk" schools, Shabazz (1995) is convinced that all students can learn quantitative methods. This is particularly true if students come to class prepared and are willing to learn, and instructors have genuine interest of the students in mind. Recent studies show that all students do not learn in similar ways. African American students are said to learn best via visually-aided instruction, rather than lecture monologs. They prefer to have knowledge demonstrated to them in a variety of

ways. Also, they are more expressive, and enjoy participating in live discussions.

This consensus that all students can learn has led to a number of innovative ideas in college instruction that are considered more effective than the traditional, lectures only method. The traditional lecture, which is more suitable to the "bureaucratic model" of education -in which age-graded students are taught in one class room -assumes that all students learned in similar ways. In the lecture only method, instructors come to class, teach and ask questions during a discussion segment. Students are assumed to be highly motivated and independent. Those who have problems are asked to go to tutorials and/or to their fellow students to get help. Here, teaching and learning styles are not usually a major problem. The traditional lecture is very effective especially when an objective is to cut costs of hiring an additional instructor, as in large universities. Thus the student/teacher ratio is very high in colleges in which the traditional lecture is the main mode of instruction.

But where a special one-on-one attention to students is required for effective learning, as is the case at many HBCU's the traditional, lecture only, format breaks down. This strategy therefore fails to address the academic needs of African American students. To get and keep the attention of African American students requires, a mix of techniques and strategies are needed which may include the lecture, but is not limited to the traditional lecture.

Financial Obligations of Students

Gibbs (1996) showed that lower family incomes, lower parental educational attainment, and for many, poorer homes, undoubtedly provide fewer resources and less motivation for rural African Americans to go to college. Being African American and living in the southern United States in itself spells financial trouble for most students who attend college. Parents of most of these students did not attend college, and work in manufacturing and service occupations. In addition, these students often have very little money saved by their parents for their college education. Also, since many come from "at risk" school districts, they are not likely to qualify for academic scholarships that require higher scholastic aptitude test scores. As a result, many of these students must depend either on financial aid for tuition and boarding, and/or are compelled to work for supplemental income. Students now work full or part-time, on or off-campus to supplement their income for college and personal needs. Those students whose parents earn sufficient income to disqualify them from receiving aids, are therefore compelled to take out loans.

The link between labor market factors (full or part-time jobs) and educational attainment while in college seems rather obvious. Those students who work, also skip most classes and therefore have the tendency to fall behind in their school work. Missing lessons in quantitative courses that require students' full attention spells bad grades and a potential for dropping out of the class altogether. College instructors have to deal with both in and out of class problems of this category of students.

THE IN-CLASS ASSIGNMENT: A METHOD OF TEACHING AND LEARNING

An instructor faced with the limitations students bring to class must seek alternative approaches that enhance students' abilities to learn. To effectively teach quantitative courses to students with limited mathematical backgrounds, an instructor must extensively and intensively engage them in selected in and out of classroom activities that enhance learning. Experience shows that if actual lecture time is limited to 20-25 minutes of the class period, it is possible to maximize class time by augmenting lectures with in-class exercises that give students opportunities to practice concepts being presented in class. In-class assignments appeal to a cross-section of students because they have a chance to practice materials learned while they are fresh in their minds. Also, in-class assignments enable students to acquire good learning habits and become more motivated to actively participate in class sessions involving both critical thinking and problem solving.

A typical in-class assignment segment involves exercises in which students are asked to solve problems or analyze cases within a given time frame. In practice, students are encouraged to solve problems at speeds similar to those that obtain in examination conditions. Students may work individually and in groups, respectively. Students who have difficulties immediately approach the instructor to clarify any doubts they might have. Considerable success is achieved when the questions are framed to reflect the socio-economic backgrounds of the student population.

The idea of in-class assignment is not new, and is similar to "case studies" popularized by Masters of Business Administration (MBA) programs in many Business Schools across the nation as early as the 1960's. A typical case study involves a reading assignment describing a specific problem found in daily business practices. Individual students or groups of students are assigned to these cases to either provide solutions or potential solutions to the highlighted problem of the particular business organization.

In quantitative courses, it is also helpful to pause in the middle of a lecture and ask questions that test whether students are attentive and are also learning the materials. Such interludes of question and answer sessions have proven successful in maximizing the use of class time. During these sessions, it is fairly easy to identify those aspects of the lecture materials students are still having problems with, and to respond to them appropriately.

Throughout the term, a large number of assignments are completed, and students are required to maintain a portfolio for their completed work. In practice, a systematic sampling enables the instructor to select few assignments for purposes of computing the average score for each student. These portfolios are collected at the end of the module and are integral parts of the evaluation process.

The in-class assignment strategy complements collaborative learning and the traditional lecture in undergraduate teaching. Research indicates that learning increases as more senses are

involved in the learning process. Also, information that is seen, heard, and felt is better retained than if it were only heard. Because students are impatient and have very short attention spans, traditional lectures are no longer suitable to the learning styles of students with varied backgrounds and preparations. Therefore in addition to brief lectures, individual and group assignments given in-class, enable the practice and an assessment of the extent of what is taught that is being assimilated.

An outstanding advantage of the in-class assignments is that students can be observed doing their work either individually or in groups. Cheating is discouraged in the presence of the instructor. Personalized comments by the instructor made on each students' papers encourages students to build trust in their instructor, who have come to understand and respect their feelings and their genuine efforts to succeed, in spite of the limitations students bring to class.

CONCLUSION

The in-class assignment enables an instructor to address some of the needs of a majority of students who otherwise would be discouraged to enroll in quantitative courses. These students already are made to believe that they cannot learn quantitative skills. The traditional lecture only is very ineffective in teaching students who are inadequately prepared for college, and who have poor learning habits.

The in-class assignment method leads to an improvement in test scores, an increase in students interests to learn

statistics, a decline in the rate of absenteeism, and an overall positive attitude toward achievement. Testimonies from students show that the in-class assignments enabled them to alter their attitude toward learning quantitative skills. Those who enrolled in graduate programs make only favorable remarks for the strategy in preparing them for the more challenging quantitative courses in graduate schools.

The attitude of students toward learning quantitative courses is observed to change, as it has become clearer to them that quantitative courses enhance their critical thinking and analytical abilities; skills required to succeed in contemporary America. Because students become more and more interested in the course as they get confident in solving problems, the rate of absenteeism declines, and test scores rise significantly. Some students were still not convinced that they should be subjected to the level of work required by the in-class assignment approach. These few students were interested in obtaining only the basic knowledge of quantitative skills required to succeed.

The in-class assignment strategy can easily and effectively be adopted by instructors who have genuine interests in improving the performance of students that are enrolled in colleges and Universities across the country. Each instructor must be prepared to accommodate the extra work due to a large number of assignments that are possible in using the in-class assignment method.

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